REMARKS

Applicant respectfully requests reconsideration of the presently active claims, numbers 1, 2, 5, 15, 18, 28-30 as amended without the addition of new matter.

The final status of the elected claims, as determined by the Office Action, is acknowledged. Applicant is not in agreement with the determination made, but further reconsideration cannot be requested at this time. However, applicant specifically reserves the right to reinstate inclusion of currently withheld claims that are within the scope of generic or parent claims that are subsequently found to be allowable.

Claim objections – Claims 15, 18 and 28 were objected to because of informalities, and applicant has amended claims 15 and 18 in accordance with suggestions kindly made in the Office Action.

The suggestion as to claim 28, however, has not been adopted, inasmuch as the term "makeup" is appropriate, as noted below. However, the language at lines 14 and 15 dealing with this same terminology has been revised to state that "with thread makeup to an operative penetration in the coupling", and this is believed to be clear and appropriate.

Claim rejections -- 35USC§112 – Claims 2 and 15 were rejected as indefinite in using the phraseology "the hand tight plane". In oil field equipment terminology, this commonly accepted language is used to designate the physical relationship between threaded elements at which manual rotation encounters abrupt resistance. With tubing and casing threads, which are tapered, the elements initially turn readily, but the precision is such that there is a well-defined position at which hand turning is abruptly no longer feasible. This stoppage point is referred to as the "hand tight plane", and is significant because further turning to increase the axial engagement requires the application of

significant torque. Sometimes the torque level that is reached is itself measured, directly or indirectly, and this is called the "torque displacement" approach. The torque applied can be indicated by a suitable display, such as a hydraulic pressure reading. Some prefer to use markers or other indicia to show the number of degrees of relative rotation, and this is called the "circumferential displacement" technique. The term "hand tight plane" thus is used to define a significant operative state in the field, and it establishes a starting criteria for securing one length of tubing or casing to another by an intervening coupler. With sucker rods, which have threaded ends that are not tapered, the hand tight plane in prior art API designs constitutes engagement of the pin end shoulder against the coupling end. Thereafter, thread makeup requires additional rotational engagement to assure retention, as pointed out in the in the specification. The "hand tight plane" expression itself, however, is equally relevant, and is found throughout the industry.

Claims 18 and 28 were rejected as indefinite because they refer to "API specifications" and "manufacturer's specifications", but this language also has not been revised for the following reasons. Sucker rod products, as well as tubing and casing products, commonly follow specifications as to size and grade that are defined by the American Petroleum Institute (API) for particular downhole conditions (such as tensile forces, internal pressure and flow rates, string length and various other conditions to be encountered). Manufacturers sometimes adopt their own specifications to guide drilling rig operators for their own products. Whatever these specifications are, and however much they may change with time, however, is not the significant factor in the claimed subject matter. Instead, such specifications prescribe nominal values, and the claims

define combinations in which the tolerances are much more closely related to the nominal values than the API or manufacturer's specifications, whatever they may be.

The reference, in the third paragraph of page 4 of the Office Action, to "claim 17" which "depends from rejected claim 16" does not appear to be applicable to the claims currently under consideration.

Claim 28 was rejected as vague and indefinite because lines 14-15 refer to "thread makeup" and "operative penetration". Some prior language has been amended, at lines 2 and 3 of this claim, but these two particular expressions have not been changed. Thread makeup is universally accepted as designating engagement (tightening) of the two threaded members, while the disengagement procedure is referred to as "breaking" the connection. The "operative penetration" refers to torquing the connection after the hand tight plane to a penetration in which the desired stress and strength relationships are established. Such language is readily understandable by those skilled in the art and defines operative relationships which add patentable weight.

As to claims 29-30, the prior discussion of "hand tight plane" as to claims 2 and 15 provides the basis for the language "torque or circumferential displacement method" on the basis of which the claims are rejected. It must be understood that there cannot be useful operative connection between successive sucker rods unless they are tightened in some manner, and with a significant stress level. Using a term such as "displacement method" therefore merely makes short hand reference to an expression that is accepted in the art. The Office Action indicates that as to claim 29, the term "pin end shoulders" on line 4 has no antecedent basis. Applicant appreciates the suggestion made to overcome

this deficiency, but instead has amended the terminology of claim 29 at line 3 to incorporate a positive recitation of pin neck areas and adjacent end shoulders.

Claim rejections – 35USC§102(b) – Claims 1, 2, 5, 15 and 29 were rejected to 102(b) as being anticipated by Palone, U.S. Patent 3,859,503. In response, applicant submits that for reasons given below the Palone reference is not applicable in any way, and that the Section 102 rejection is inappropriate. Nonetheless, applicant has, in order to advance the prosecution, extensively reviewed the claims currently active in the light of the Restriction Requirement and has inserted clarifying terminology to make the distinctions even more clear.

It should be appreciated at the outset, however, that over the many years of usage of sucker rods, predominantly of API specification, the industry has studied the problems of wear and useful life extensively and at great expense, because the economics of field operations are to a substantial extent defined by the reliability and life of the continuously operating pumping string. The introduction to the present specification makes clear that advanced studies in the recent past, such as these by Takacz and Hoffman (Sandia), have shown much about the points of failure and have revealed primary causes of such failures with reasonable certainty. These studies, which are concerned in detail with the prestresses introduced in properly made up sucker rod couplings in anticipation of loads, cycling and fatigue problems, establish the state of the art, in contrast to which Palone says nothing about any of these factors. To the extent there is a superficial physical similarity on casual inspection, the relevance of Palone disappears immediately after a more detailed analysis is started.

Applicant faced the formidable task of confronting the subtle factors confronting sucker rods made to API specifications without introducing sucker rod designs which are uneconomic by comparison. Applicant is believed to be the first to suggest configurations which, within the standard API context, establish tensile and compressive prestresses such that they not only enhance the engagement of the members, but unite them physically in such a way as to inhibit the introduction and subsequent growth of microcracks and other causes of fatigue failure that are induced by millions of operating cycles. In this context, as evidenced by actual results affirmed in the specification, applicant has shown that with particular modifications and with specific dimensional and prestress relationships, significant benefits in ultimate life and consequent economic benefits are derived. A number of the withheld claims pertain to a different system which is not consistent with API specifications, but these nonetheless establish a number of like advantages.

To emphasize the points being made herein, applicant has attached highlighted copies of pages 54 to 56 and 76 and 77 from the Takacz publication, and pages 25 to 27 from the E. L. Hoffman report (Sandia Laboratories). Both these documents show, in the attached pages, the dominant significance of prestress values and distributions. They also demonstrate use of common oil field terms such as “hand tight” and "make up". Furthermore, they emphasize the cycling variations inherent in reciprocal pumping operations, and the factors which must be considered in properly making up a coupling. The existing prestress distributions (under API designs) are also detailed at considerable length in Takacz. A significant fact, mentioned in the present application, is that down

cycles can introduce compressive loads, and these are shown in Hoffman in relation to "cycle 1" in Figs. 11 and 12.

It is evident, therefore, that the teachings of Palone, who was concerned only with using an embedded electrical heating circuit along the length of a sucker rod string to heat a high viscosity oil as it is pumped, is completely irrelevant to the present state of the art as to the improvement of couplings themselves and the reduction of fatigue life.

As to the analysis of claim 1 in the second paragraph of page 5 of the Office Action is correct only as regards the first four lines thereof, inasmuch as this part of the analysis is merely a reiteration of the different parts of a standard API sucker rod connection, with pin ends that are threaded, separated from a radial shoulder by a pin neck portion and engaged into one end of a coupler which also receives another pin end from the opposite direction. The analysis is not correct in ascribing to Palone the use of pin ends "dimensioned in length relative to the coupler" so as to "provide compressional engagement between the opposing pin ends" when a "predetermined penetration" is used during makeup. Palone speaks only of contact between small protruding end points 50 within the members 52 of his Fig. 1. The members 52 are actually plastic elements (col. 4, line 28 of Palone) for electrical isolation of the central conductive projections 50 from the surrounding wall of the coupling. In actuality there can be no "compressional engagement" between pin ends because of the fact that these projections merely contact against the ends of the central heating elements within the sucker rods, which comprise only central resistance wires 48 within an insulation layer, which may be of mineral material (Col. 4 lines 2-10 of Palone). It is evident that the heating element, including its insulation, cannot bear any meaningful compressive load, so that no prestress can be

communicated from the Palone pin end to the coupling because of the presence of this internal member.

Moreover, Palone does not show or suggest, or in any way create the impression that he is concerned about, establishing a prestress relationship. The patent does not even describe the extent of the force that is needed to maintain adequate point-to-point contact in the electrical circuit along the central axis. Palone is directed solely to the problem of heating the sucker rod, and consequently the thick oil that is being pumped, so as to reduce the thickness and viscosity of the oil, and minimize paraffin buildup. Inherently, wear and fatigue life and operation under normal conditions in a mechanical and dynamic sense must be sacrificed in Palone because be eliminating the sucker rod central core in order to introduce the central heating element. Palone's technique converts the sucker rod to a sucker tube, reducing both strength and rigidity and teaching away from applicant's concept.

One particular operative factor shows the inapplicability of the Palone teaching to anything more than the specific heating problem which he has confronted. Because a central electrical circuit within the sucker rods is to be joined electrically to the conductive part of the interior spacer, this means that any significant compression will merely impact the central projection on the spacer and probably ultimately deteriorate the electrical circuit as well. The necessity for prestressing the pin ends in an API-type connection (as shown by Takacz and Hoffman) is inconsistent with the need in Palone for keeping a closed electrical circuit at all times. Therefore, for this additional reason, the Palone reference cannot be extended beyond its sole purpose of heating the sucker rod and oil.

Claim 1 distinguishes in accordance with the terminology previously used. However, consistent with the stated intention of advancing the prosecution, claim 1 has been amended to specify the flat transverse end faces on the sucker rods, and length dimensions in the pin ends relative to the coupler to provide "compressional loading forces between opposing ends faces" of the pin ends when the threaded sections are "matingly inserted to preselected penetrations in the coupler past engagement of the coupler engagement members with the coupler ends". The pin end faces taught by Palone are not flat because they have a central aperture for the heating element, they do not introduce compressional loading forces between opposing and faces of the pin ends and there is no prestress condition, involving "penetrations in the coupler past engagement of the coupler engagement members with the coupler ends". In order to introduce the compression in the central area of the connection, contact and substantial forces generated between the pin end faces, the tensions may be introduced by direct engagement between the pin end faces, or, as in claim 5, by engagement against opposite sides of a intervening torque washer.

Thus in setting forth a wholly different operative concept in patentable terms of elements and operative relationships, claim 1 as amended patentably distinguishes over the Palone patent.

On page 5 of the Office Action, claim 2 is rejected on the basis of a recitation of relationships and distinguishing features recited in claim 2 in its original form, but wholly without any support in the cited Palone patent. Applicant has carefully reviewed Palone but submits that there is no basis whatsoever in that patent for the assertion as to the pin end sections being in compression and the associated coupler sections being in tension, or

the mating threads locking under prestress. Accordingly, just as parent claim 1, application of the full anticipation rejection under ¶102 is wholly inappropriate. Nonetheless, given the possibility that the claim has been misconstrued, claim 2 has been amended to define further the lengths of the pin ends and the coextensive extensions of the coupler which are in tension and compression respectively.

Claim 5, also dependent from claim 1, was also rejected as fully anticipated by Palone on the basis that conductive element 58 (of Palone) is the same as a "torque washer" as defined in claim 5. The conductor 58 is merely a circuit element disposed between the end rod 44 and the central electrical resistance element 46 in Fig. 2 of Palone and does not participate in any way in introducing compressive forces in the structure. Again, the lack of substantial support in the Palone patent for this language in claim 5 establishes that the section 102 rejection is inappropriate. To place this language beyond misinterpretation, explanatory language has been added to claim 5 as to the flat transverse sides of the torque washer.

Claim 15 is an independent claim, rejected on Palone on a number of seemingly gratuitous interpretations not supported by the substance of that reference. Palone says nothing whatsoever about fatigue resistance. Consequently the recitation of various elements, in accordance with the marked up copy of Palone supplied with the Office Action, does not support any argument that the elements are arranged to "prestress at least portions of the male threaded sections of the pin ends under compression" and "associated portions of the coupler in tension" where there is a "selected displacement past the hand tight plane". If Palone discloses anything more than point to point engagement without prestress, it cannot be found in that reference.

On page 6 of the Office Action, claim 29 is rejected as essentially relying upon a functional limitation. This is not the case, since claim 29 recites compressive contact forces "between the pin end shoulders and coupling and areas and pin thread end areas and the torque disk", which alone distinguishes over the reference. The further operative relationship that recites that the prestress in the made up coupled unit is to be to a "degree calculated so as to be higher for each sucker rod size and material than any stresses induced by future operating loads" is not a wishful statement of result but a measurable parameter that further adds to patentability. Again, the claim has been amended to make these distinctions more clear. The argument in the Office Action that the principle of "inherency" is applicable is respectfully traversed. Palone would certainly not perform the function claimed because his sucker rod connection is incapable of prestressing, much less reaching a particular value limit.

Claim rejections – 35USC§103 – Claims 18 and 28 were rejected as obvious in light of Palone, but in the course of doing so the Office Action has had to rely on a sequence of assumptions and gratuitous conclusions for which Palone supplies no support. Thus the Office Action is traversed as to its allegations that Palone teaches a shoulder spaced from the end plane "by a prestress dimension", that it has a "torque disk having parallel planar faces", that "the spacing between the pin ends and the shoulders and the axial distance between torque disk faces are selected" to place the end regions of the coupling "in compression coextensive with the pin neck regions and in tension coextensive with the torque disk", and with pressure and frictional contact being maintained as specified. The Office Action concedes that the "proportions" are not explicitly disclosed but suggests that deviations "less than 0.005" are well within the

scope of Palone's disclosure. In view of the fact that Palone says nothing about these tensions, the statement could be true only in the sense that Palone encompasses everything without saying anything meaningful. The argument on page 8 of the Office Action that optimization of proportion is a "design consideration" within the skill of the art" does not apply generally, and is certainly not true where a new combination having distinctly superior tensile and life properties under highly cyclic load conditions apply accordingly, the subjective conclusion that obviousness exists is not supported.

Claim 28 is submitted to distinguish patentability over Palone on essentially the same basis as claim 18, and so the above argument is incorporated by reference.

The references that have been made of record and not applied have been reviewed and they are not relevant to this subject matter being claimed.

In the light of the above considerations, favorable review of claims 1, 2, 5, 15, 18 and 28-30, as amended, is respectfully requested.

A marked up copy of the amended claims is attached hereto, along with copies of the Takacz and Hoffman excepts with emphasis added

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MARKED UP CLAIMS

I claim:

1. A connection for sucker rods used in strings in petroleum wells comprising:

a pair of sucker rods, each having a pin end with ~~an~~ a flat transverse end face and at least an adjacent male threaded section;

a coupler having at least two interior female threaded sections receiving the male threaded sections of the pin ends, wherein the pin ends of the sucker rod ~~includes~~ include coupler engagement members spaced apart from the end faces; and

the pin ends are dimensioned in length relative to the coupler to provide compressional ~~engagement~~ loading forces between opposing end faces of the pin ends when the male and female threaded sections are matingly inserted to ~~a~~ preselected penetration past engagement of the coupler engagement members with the coupler in the coupler.

2. A connection as set forth in claim 1 above, wherein the preselected ~~insertion~~ penetration for each pin end is to a chosen displacement beyond insertion to the hand tight plane, whereby pin end sections from the end faces are in compression and ~~associated~~ coextensive lengths of the coupler ~~sections~~ are in tension and the mating threads lock under prestress to inhibit relative movement.

5. A connection for sucker rods as set forth in claim 1 above, further including a torque washer of a selected axial dimension with flat transverse sides and disposed centrally in the coupler between the pin end faces and engaged ~~each~~ on side by the flat end faces of the pin ends.

18. A connection for sucker rods used in pumping in oil well installations, comprising:

a sleeve coupling with an interior female threaded surface and dimensioned in accordance with API specifications and having end walls of given radial dimension;

a pair of sucker rod pin ends, each threaded into the coupling from a different end, each of the pin ends having a male threaded end portion with an end face transverse to the longitudinal axis of the rod that deviates less than about

0.0005" from an end face plane, a transverse shoulder spaced from the end plane by a pre-stress dimension, and an undercut pin neck between the root thread of the male thread and the transverse shoulder, and

a torque disk having parallel planar faces spaced apart by a predetermined axial distance the faces deviating from a plane by less than about 0.0005 inches and the torque disk being of different material than the pin ends,

where the spacings between the pin ends and the shoulders, and the axial distance between torque disk faces are selected such that with thread makeup to an operative tightness the end regions of the coupling are in compression coextensive with the pin neck regions and in tension coextensive with the torque disk, and pressure and frictional contact are maintained between the pin ends and torque disk and the end walls of the coupling and the pin shoulders.

28. A connection for sucker rods used in pumping installations in oil wells, comprising:

a sleeve coupling with interior counter bores at each end region and with an interior and female threaded surface between said counter bores and dimensioned in accordance with API or manufacturer's specifications and having end walls of given radial dimension and axial dimension within tolerances of ±0.0005 in. relative to nominal dimensions;

a pair of sucker rod pin ends, each threaded into the coupling from a different end, each of the pin ends having a male threaded end portion with an end face transverse to the longitudinal axis of the rod that deviates less than about 0.0005 in. from a nominal end face plane, a transverse shoulder spaced from the end face plane by a pre-stress dimension, and an undercut pin neck between the root of the male thread and the transverse shoulder, and

a torque disk having parallel planar faces spaced apart by a predetermined axial distance between torque disk faces selected such that the thread makeup to an operative penetration the end regions and the coupling are in compression coextensive with the pin neck regions and the center region of said coupling in tension coextensive with the torque disk, and compressive force and frictional contact are maintained between the pin ends and the end walls of the coupling and the shoulders.

29. A sucker rod coupling unit comprising:

a sleeve coupling and two sucker rod pin ends with predetermined dimensional criteria and made up with torque or circumferential displacement methods to establish compressive contact forces between the pin end shoulders and coupling end areas and pin thread end areas and torque disks, and tension force in pin neck area and in the mid region of the sleeve coupling;

said induced forces imparting a pre-stress into the made up coupled unit at a degree calculated as to be higher for each sucker rod size and material than any stresses induced by future operating loads.

30. A coupling unit as in claim 29 with dimensions such that when made up with either torque or circumferential displacement method establishes a pre-stress in the unit that eliminates detrimental relative movement between the three combined parts approaching or at the microstructure level of the materials used in the parts.